(12) UK Patent Application (19) GB (11) 2 358 353 (13) A

(43) Date of A Publication 25.07.2001

(21) Application No 0001253.4

(22) Date of Filing 20.01.2000

(71) Applicant(s)
Corin Limited
(Incorporated in the United Kingdom)
The Corinium Centre, CIRENCESTER,
Gloucestershire, GL7 1YJ, United Kingdom

(72) Inventor(s)
Ian Hamilton Paling
Jenny Elizabeth Pickard
Caradoc John Morgan Thomas

(74) Agent and/or Address for Service
A R Davies & Co
27 Imperial Square, CHELTENHAM, Gloucestershire,
GL50 1RQ, United Kingdom

(51) INT CL[7]
A61F 2/34

(52) UK CL (Edition S)
A5R RABA

(56) Documents Cited

GB 2333961 A	GB 2316873 A	GB 2117646 A
EP 0958797 A	EP 0245527 A	EP 0139356 A
DE 019616058 A	US 5879397 A	US 5725591 A

(58) Field of Search
UK CL (Edition R) A5R RABA
INT CL[7] A61F 2/34
ONLINE: EPODOC, WPI, JAPIO

(54) Abstract Title
Acetabular cup

(57) A two-piece acetabular cup comprises an outer shell 10, and a plurality of inner liners 20. The liners 20 are selectively insertable in the shell 10. In preferred embodiments, the inner surface of the outer shell (10) and the outer surface of the inner shell (20) are tapered. Apertures (16) may be screw-threaded to receive a blanking plug to prevent debris passing through.

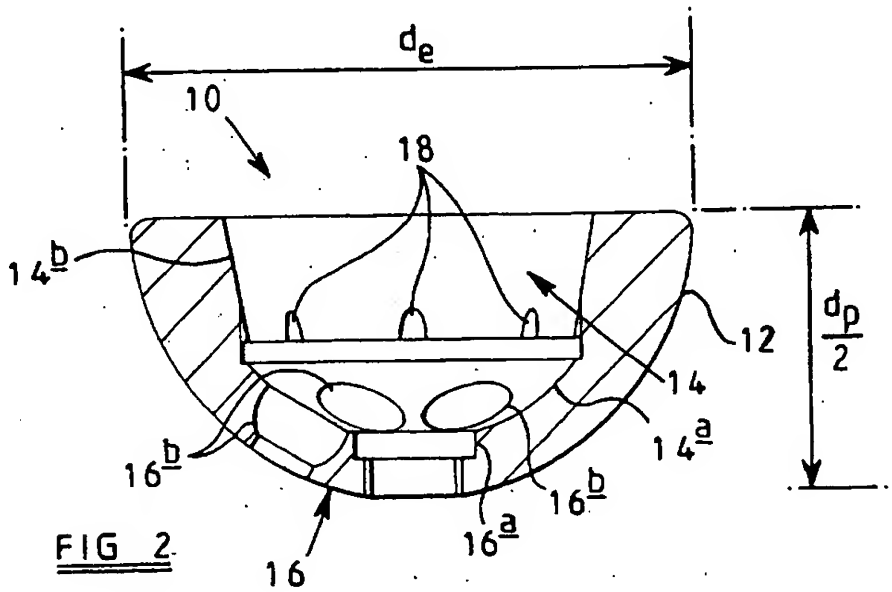

FIG 2

GB 2 358 353 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

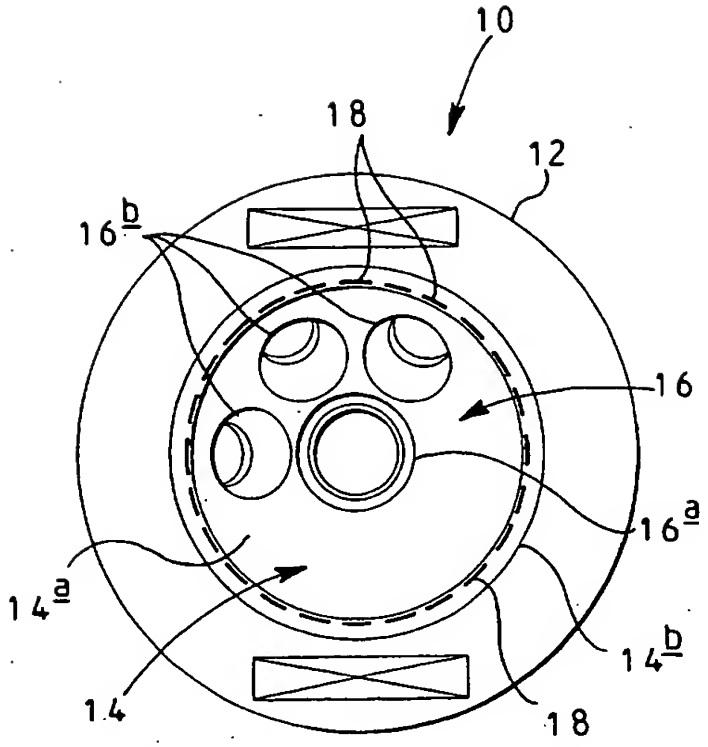

FIG 1

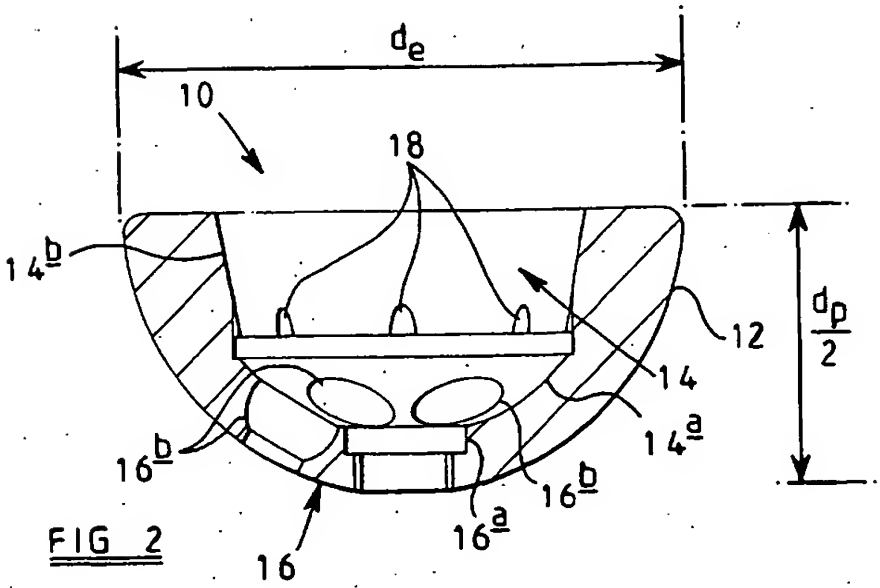

FIG 2

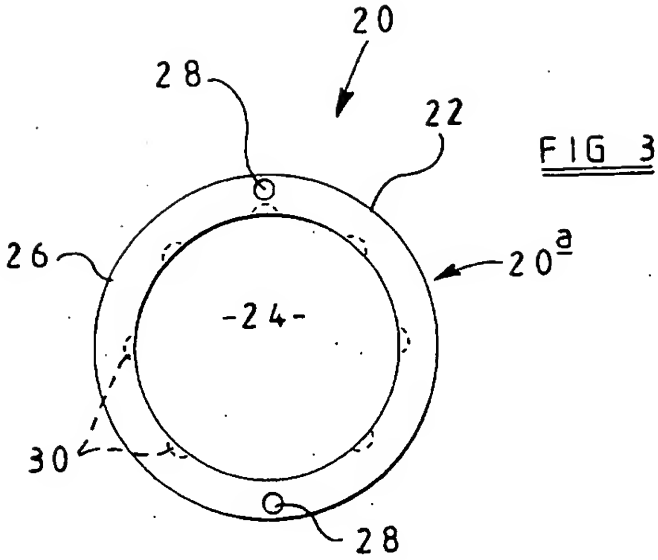

FIG 3

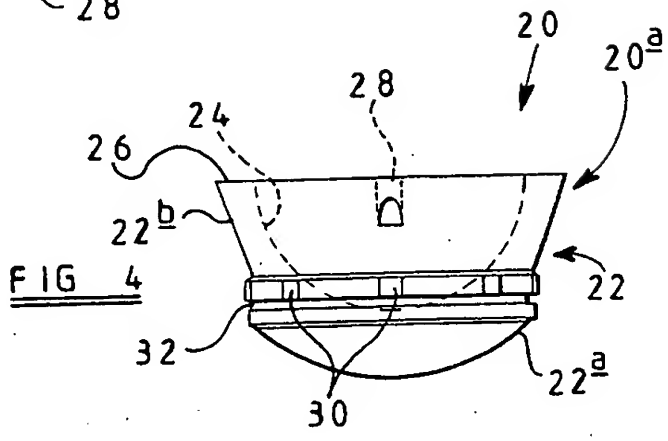

FIG 4

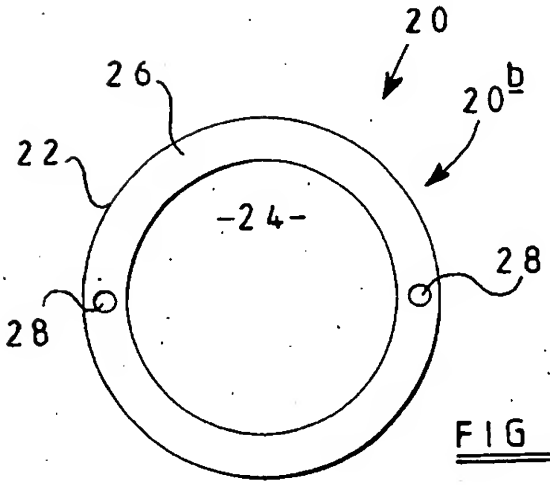

FIG 5

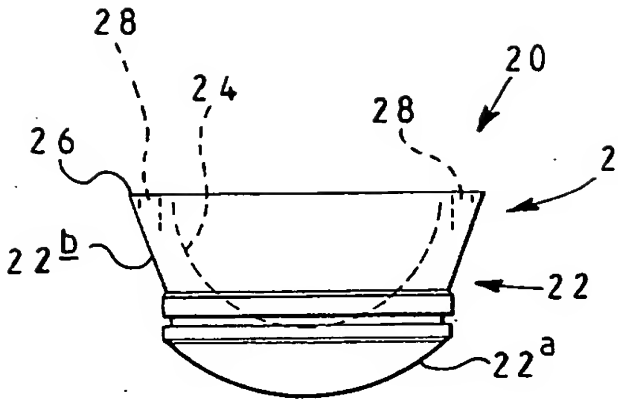

FIG 6

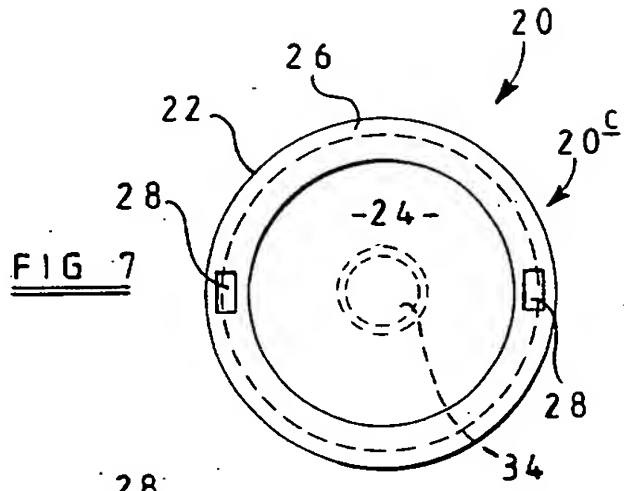

FIG 7

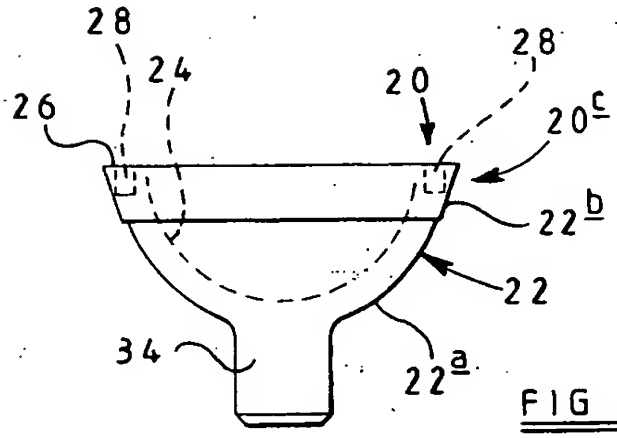

FIG 8

BNSDOCID: <GB 2358353A I >

ACETABULAR CUP

The present invention relates to an acetabular cup.

Hip prostheses commonly consist of an acetabular cup and a femoral stem having a ball joint designed to be held inside a socket in the acetabular cup. Most commonly, the femoral stem is of a metallic design, whereas the acetabular cup, on which the ball joint of the femoral stem bears, is manufactured from Ultra High Molecular Weight Polyethylene, to allow creation of a low friction bearing. However, polyethylene components abrade and it is now understood that polyethylene debris, caused as a result of abrasion through articulation, can be a primary cause of osteolysis and resultant failure of the hip prosthesis.

Recently, there has been increased interest in the use of all metal acetabular cups providing a metal on metal bearing surface with a metallic femoral modular head. Metal on metal bearings provide an advantage in that their wear rate is typically 50 - 100 times less than for a metal/polyethylene bearing.

According to the present invention, there is provided a two-piece acetabular cup comprising an outer shell, a first inner liner and a second inner liner, the liners being selectively insertable in the shell.

The provision of an acetabular cup having a selectably insertable liner enables a surgeon to interoperatively tailor, on a case-by-case basis, the constituent

parts of the hip prosthesis to better suit a specific patient.

Preferably, the equatorial diameter of the outer surface of the shell is greater than the polar diameter thereof. This aids fixation of the acetabular cup in the patient's acetabulum.

Preferably, the outer shell has an aperture engageable by an introducing device for enabling introduction and location of the shell in a patient's acetabulum. The outer shell may also have at least one aperture capable of receiving a fixing member for fixing the shell in a patient's acetabulum.

The introducer aperture typically allows the shell to be introduced and located in a patient's acetabulum while mounted on an introducing tool directed by the surgeon. The fixing member aperture typically allows the acetabular cup to be additionally secured to the patient's acetabulum via a fixing member.

The two-piece cup may further comprise a blanking plug insertable into the aperture. In this case, the aperture may be a screw-threaded aperture and the blanking plug may be threadingly engageable with the aperture.

The blanking plug protects the patient's acetabulum from the passing of any debris through any of the apertures.

Preferably, an inner surface of the outer shell has a taper. In this case, an

outer surface of at least one of the liners may have a taper which corresponds to the taper of the outer shell and securely and releasably holds the in use liner in place.

Preferably, the taper is 17° or substantially 17° from the associated polar axis. The taper of 17° holds the liner in place sufficiently firmly to overcome applied torque forces imparted through the ball joint, but also allows relatively easy removal of the liner when circumstance dictates.

Preferably, an inner surface of the outer shell has at least one recess for receiving a corresponding protuberance provided on an outer surface of at least one of the liners. In this case, the at least one of the liners may be formed of polyethylene.

Preferably, one of the liners is formed of ceramic.

Preferably, one of the liners is formed of metal. In this case, when used in conjunction with the introducing device, the outer surface of the metal liner may have a spigot extending therefrom, the spigot being securely and releasably attachable to the introducing device aperture of the outer shell.

Preferably, the outer shell is formed of titanium.

The invention will now be more particularly described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a plan view of an outer shell of an embodiment of a two-piece acetabular cup according to the present invention,

Figure 2 is a side view of the outer shell of Figure 1,

Figure 3 is a plan view of a polyethylene inner liner of the two-piece cup,

Figure 4 is a side view of the polyethylene inner liner of Figure 3,

Figure 5 is a plan view of a ceramic inner liner of the two-piece cup,

Figure 6 is a side view of the ceramic inner liner of Figure 5,

Figure 7 is a plan view of a metal inner liner of the two-piece cup, and

Figure 8 is a side view of the metal inner liner of Figure 7.

Referring firstly to Figures 1 and 2, an outer shell 10 of the two-piece acetabular cup shown therein has a part-circular outer surface 12 of an appropriate diameter to fit into the acetabulum of a patient. The outer shell 10 also has a two-part inner surface 14 comprising a part circular bottom surface 14a and a frusto-conical wall 14b. The outer shell 10 is formed of metal, preferably titanium.

A plurality of apertures 16, typically screw-threaded, are provided in the bottom surface 14a of the outer shell 10. One aperture 16a of the plurality of apertures 16 is typically provided coaxially with the polar axis of the part circular bottom surface 14a. The remaining apertures 16b are clustered about the central aperture 16a with an equi-angular separation between first-second and second-third apertures 16b. Longitudinal axes of the apertures 16b extend perpendicularly to the bottom surface 14a, and the equi-angular separation may typically be 60°.

The frusto-conical wall 14b of the outer shell 10 has a converging taper in the direction of the bottom surface 14a. The taper is 17° or substantially 17° from the polar axis of the bottom surface 14a.

Recesses 18 are provided in the frusto-conical wall 14b, substantially at a shoulder formed between the bottom surface 14a and the frusto-conical wall 14b.

To improve the fixation of the outer shell 10 in the acetabulum of the patient, the outer surface 12 may be textured and/or comprise a plurality of splines (not shown). To further aid fixation, the outer shell 10 is shaped such that the equatorial diameter d_e of the outer surface 12 is greater than the polar diameter d_p of the outer surface 12. The acetabulum is then reamed to the same dimension as the polar diameter d_p. The outer shell 10 can be offered up to the acetabulum by screw-threadingly attaching the outer shell 10 through the central aperture 16a to an introducing device. The outer shell 10 is then jammed into the acetabulum due to the larger equatorial diameter of the outer shell 10. This is particularly advantageous in the case of introducing metal shells for metal-on-metal articulation since the larger frictional torque forces imparted by the femoral stem can cause the entire cup to tear out of the acetabulum before it can become fixed by bone growth.

In addition to the hemispherical expansion of the outer surface 12, a fixing member (not shown) may be threadingly insertable through one or more of the clustered apertures 16b, whereby the outer shell 10 is securely fixable by the fixing

member to the patient's acetabulum. A blanking plug (not shown) is also threadingly engageable with each of the plurality of apertures 16, so that debris is prohibited from passing therethrough.

The outer surface 12 of the shell 10 may be coated with artificial bone substitute material, such as Hydroxyapatite, or the surface may have a porous coated or plasma coated surface to enhance fixation of the shell 10 within the acetabulum of the patient.

Referring now to Figures 3 to 8 of the drawings, an inner liner 20 is selectable from a plurality of liners 20 formed of different materials. The inner liner 20 of the two-piece acetabular cup has a two-part outer surface 22 of an appropriate diameter to be releasably insertable with an interference fit in the outer shell 10. The outer surface 22 is formed with a part circular bottom surface 22a and a frusto-conical wall 22b having a taper of substantially 17°. The inner liner 20 also has a partly circular, typically hemispherical or substantially hemispherical, articulating surface 24 having a diameter appropriate for receiving a femoral head (not shown). The diameter of the articulating surface 24 is typically within the range of 40 to 60 millimetres.

Extending between the outer surface 22 and the articulating surface 24 is an annular rim 26. The surface of the rim 26 is planar. The rim 26 is provided with two diametrically opposed introducer recesses 28 able to receive prongs of an introducing tool (not shown). The recesses 28 open out into the rim 26 and these

openings are spaced from the outer surface 22 and the articulating surface 24. In providing the recesses 28 in the rim 26 of the liners 20, the articulating surface 24 is not compromised and this helps to minimise the wear between the femoral head and the articulating surface 24.

The inner liner 20 shown in Figures 3 and 4 is a plastics, typically Ultra High Molecular Weight Polyethylene, inner liner 20a. The radius of the bottom surface 22a of the outer surface 22 is substantially equal to the radius of the bottom surface 14a of the inner surface 14 of the outer shell 10. The frusto-conical wall 22b has a converging taper in the direction of the bottom surface 22a. The taper is substantially the same as that of the frusto-conical wall 14b.

Protuberances 30, corresponding to recesses 18 in the outer shell 10, are provided on a neck portion 32 extending between the bottom surface 22a and the frusto-conical wall 22b. On insertion of the inner liner 20a into the outer shell 10, a latch mechanism is created whereby the protuberances 30 and recesses 18 , when aligned, interlocate with each other.

The inner liner 20 shown in Figures 5 and 6 is a ceramic inner liner 20b, and it should be noted that like reference numerals correspond to parts similar to those of the plastics liner 20a.

The ceramic liner 20b, out of the necessity of having to also fit the outer shell 10, is substantially the same as the plastics liner 20a. However, the taper of the

frusto-conical wall 22b is identical to the taper of the frusto-conical wall 14b of the outer shell, enabling the neck portion 32 and protuberances 30 of the plastics liner 20a to be omitted. In this way, on insertion of the ceramic liner 20b into the outer shell 10, a taper fit is generated between walls 14b and 22b. Tapers of 17° or substantially 17° from the polar axes of the bottom surfaces 14a and 22a enable the ceramic liner 20b to be held in place sufficiently firmly to overcome applied torque forces imparted through the ball joint, but allows relatively simple removal of the ceramic liner 20b when circumstance dictates.

The inner liner 20 shown in Figures 7 and 8 is a metal inner liner 20c, and it should be noted that like reference numerals correspond to parts similar to those of the plastics liner 20a.

The metal liner 20c, out of the necessity of having to also fit the outer shell 10, is substantially the same as the plastics liner 20a. However, the outer surface 22 of the metal liner 20c has a spigot 34 integrally extending therefrom, enabling the protuberances 30 of the plastics liner 20a to be omitted. The spigot 34 is typically screw-threaded for engagement with the introducer aperture 16a of the outer shell 10. In this way, on insertion of the metal liner 20c into the outer shell 10, not only is a taper fit producible between frusto-conical walls 14b and 22b, but also a secure and releasable screw-threaded attachment is formed between the metal liner 20c and the outer shell 10.

The provision of a two-piece acetabular cup having a selectably insertable

liner enables a surgeon to interoperatively tailor, on a case-by-case basis, the constituent parts of the hip prosthesis to better suit a specific bone stack of a patient. Comparisons of various working combinations can also be performed away from the operating table. The three types of inner liner of the acetabular cup provide for the following combinations of hip prosthesis: ceramic ball-head on ceramic liner, ceramic ball-head on polyethylene liner, metal ball-head on polyethylene liner, polyethylene ball-head on polyethylene liner, and metal ball-head on metal liner.

Although the two-piece acetabular cup is described as having three selectively interchangeable inner liners of differing materials, it may have only two or may have more than three.

The embodiment described above is given by way of example only and various modifications will be apparent to persons skilled in the art without departing from the scope of the invention.

CLAIMS

1. A two-piece acetabular cup comprising an outer shell, a first inner liner and a second inner liner, the liners being selectively insertable in the shell.

2. A two-piece cup according to claim 1, wherein the equatorial diameter of the outer surface of the shell is greater than the polar diameter thereof.

3. A two-piece cup according to claim 1 or claim 2, wherein the outer shell has an aperture engageable by an introducing device for enabling introduction and location of the shell in a patient's acetabulum.

4. A two-piece cup according to any one of the preceding claims, wherein the outer shell has at least one aperture capable of receiving a fixing member for fixing the shell in a patient's acetabulum.

5. A two-piece cup according to claim 3 or claim 4, further comprising a blanking plug insertable into the aperture.

6. A two-piece cup according to claim 5, wherein the aperture is a screw-threaded aperture and the blanking plug is threadingly engageable with the aperture.

7. A two-piece cup according to any one of the preceding claims, wherein an inner surface of the outer shell has a taper.

8. A two-piece cup according to claim 7, wherein an outer surface of at least one of the liners has a taper which corresponds to the taper of the outer shell and securely and releasably holds the in use liner in place.

9. A two-piece cup according to claim 7 or claim 8, wherein the taper is 17° or substantially 17° from the associated polar axis.

10. A two-piece cup according to any one of the preceding claims, wherein an inner surface of the outer shell has at least one recess for receiving a corresponding protuberance provided on an outer surface of at least one of the liners.

11. A two-piece cup according to claim 10, wherein the at least one of the liners is formed of polyethylene.

12. A two-piece cup according to any one of claims 1 to 9, wherein one of the liners is formed of ceramic.

13. A two-piece cup according to any one of claims 1 to 9, wherein one of the liners is formed of metal.

14. A two-piece cup according to claim 13 when dependent on claim 3, wherein the outer surface of the metal liner has a spigot extending therefrom, the spigot being securely and releasably attachable to the introducing device aperture of the outer shell.

15. A two-piece cup according to any one of the preceding claims, wherein the outer shell is formed of titanium.

16. A two-piece acetabular cup substantially as hereinbefore described with reference to the accompanying drawings.

Application No: GB 0001253.4 **Examiner:** Susan Chalmers (Mrs)

Claims searched: 1-16 **Date of search:** 13 June 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): A5R: RABA

Int Cl (Ed.7): A61F: 2/34

Other: ONLINE: EPODOC, WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
Y	GB 2333961 A	(CORIN MEDICAL) see recesses 14, page 4 lines 1-3 and page 6 lines 1-8	2,3
Y	GB 2316873 A	(BRISTOL-MYERS SQUIBB) see especially Figure 2 and page 3 lines 7-14	11-15
X	GB 2117646 A	(NATIONAL RESEARCH DEVELOPMENT CORP) see whole document especially the Figures and page 3 lines 83-96	1,4,11-13, 15
X	EP 0958797 A	(OSTEONICS) see especially column 5 lines 12-17, column 6 line 19 to column 8 line 32 and column 9 lines 18-51	1,4,7-13 and 15
Y	EP 0245527 A	(SULZER) see Figures and page 3 line 26 to page 4 line 25	7,8,10,11; 13
Y	EP 0139356 A	(HOWMEDICA) see eg Figures 6 and 8 and page 4 line 17 to page 6 line 7	7,8,10,11, 13
Y	US 5879397	(CERASIV) see whole document especially column 2 lines 37-59	7-9,11-13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Application No: GB 0001253.4 **Examiner:** Susan Chalmers (Mrs)

Claims searched: 1-16 **Date of search:** 13 June 2000

Category	Identity of document and relevant passage		Relevant to claims
X	US 5725591	(JOHNSON & JOHNSON) see whole document especially Figure 1, column 1 lines 54-58 and column 3 lines 55-59	1,4,10
X	DE 19616058 A	(PFAFF) see Figures 1 and 2 and column 2 line 40 to column 3 line 24	1,7,8,12, 13

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.